



## PROPULSION AND PROPELLERS—DESIGN A PROPELLER

*Students will have a basic understanding of how a propeller works. (One in a series.)*

### LESSON PLAN

#### Lesson Objective

The students will:

- Be introduced to the engineering process as they build, evaluate and modify propeller designs for a hand – launched propeller helicopter.
- Learn to collect and analyze data as they modify the design.
- Understand propulsion using propellers.

#### Goal

In this lesson, students will work in teams and gain a basic understanding of the engineering process and propeller driven propulsion.

#### The Engineering Design Process

This lesson plan uses the Engineering Design Process created by “Engineering is Elementary” which in turn was developed of the Museum of Science, Boston. No federal endorsement is implied. This Engineering Design Process has five steps and uses terms elementary students can understand.

#### ***WHAT IS THE GOAL?***

**ASK:** What is the problem? How have others approached it? What are your constraints or limits?

**IMAGINE:** What are some solutions? Brainstorm ideas. Choose the best one.

**PLAN:** Draw a diagram. Make list of materials you will need.

**CREATE:** Follow your plan and create something. Test it out!

**IMPROVE:** What works? What doesn’t? What could work better? Test it out!

It is important to note that the Engineering Design Process (EDP) is flexible. There are as many variations of the model as there are engineers and engineering teams. Since this is a cycle, there is no official starting or ending point. You can focus on one step, move back and forth between steps, work on one of two steps, then pass the project to another team or begin again to refine the propeller helicopter.

Propulsion and Propellers—Design a Propeller Lesson Plan

**Grade Level:** Grades 3-5

#### **Next Generation Science Standards:**

Science and Engineering Practices:

- Asking Questions and Defining Problems
- Developing and Using Models
- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data
- Using Mathematics and Computational Thinking
- Constructing Explanations and Designing Solutions

Engineering Design:

- Defining and Delimiting Engineering Problems
- Developing Possible Solutions
- Optimizing the Design Solution

#### **Materials Required:**

- Heavy card stock or cardboard
- Drinking straws—various sizes
- Tape
- Hole Punch
- Scissors
- Caution tape, string or some method to create a “fly zone”
- Safety glasses/Eye Protection
- Measuring tape—attached to classroom wall for height estimates or measure the height of the wall and mark with tape at appropriate intervals
- Pencil or Pen

**Step 1:** Create a simple propeller helicopter. (See lesson plan “Propulsion and Propellers—Build a Simple Propeller”) Let the students conduct test flights in a designated “fly zone.” Follow recommendations for safety in the classroom.

**Step 2:** Introduce the Engineering Design Process:

- **ASK:** What is the problem? How have others approached it? What are your constraints or limits?
- **IMAGINE:** What are some solutions? Brainstorm ideas. Choose the best one.
- **PLAN:** Draw a diagram. Make list of materials you will need.
- **CREATE:** Follow your plan and create something. Test it out!
- **IMPROVE:** What works? What doesn’t? What could work better? Test it out!

**Step 3:** Organize the students into teams.

**Step 4: ASK:** What is the problem? Make a propeller-driven flying toy that can go higher than the simple propeller. How have others approached it? Review propeller shapes by visiting the National Museum of the USAF web site (<http://www.nationalmuseum.af.mil/>) under Visit and Museum Exhibits and research the topic of propellers.

What are your constraints? May only use the materials provided. (You may also want to include other materials not listed on page one—such as paper clips, different weight papers, small diameter dowel rods, etc.)

**Step 5: IMAGINE:** What are some solutions? Brainstorm ideas. Choose the best one.

Encourage students to think “outside the box.” What is the best shape? How many blades on the propeller? “What is the best size?”

**Step 6: PLAN:** Draw a diagram. Make list of materials you will need.

**Step 7: CREATE:** Follow your plan and create something. Test it out!

Follow recommendations for safety in the classroom: create a designated fly zone and wear safety glasses.

**Step 8: IMPROVE:** What works? What doesn’t? What could work better? Test it out!

Give students the option of three or more refinements to the design before a “fly-off” to determine the best design.

**See student worksheet.**

### **Resources:**

<http://www.eie.org/>

[http://www.sciencebuddies.org/science-fair-projects/project\\_variables.shtml#examples](http://www.sciencebuddies.org/science-fair-projects/project_variables.shtml#examples)

<http://er.jsc.nasa.gov/seh/PROPELLER.pdf>

NASA Engineering Design Challenges: Centennial of Flight: Propeller Design Challenge

Advanced—High School

[http://www.sciencebuddies.org/science-fair-projects/project\\_ideas/Aero\\_p018.shtml#background](http://www.sciencebuddies.org/science-fair-projects/project_ideas/Aero_p018.shtml#background)

[http://www.wright-brothers.org/History\\_Wing/Wright\\_Story/Unusual\\_Childhood/Special\\_Advantages/Special\\_Advantages.htm](http://www.wright-brothers.org/History_Wing/Wright_Story/Unusual_Childhood/Special_Advantages/Special_Advantages.htm)

[http://www.all-science-fair-projects.com/project1200\\_57\\_1.html](http://www.all-science-fair-projects.com/project1200_57_1.html)

**Resources, continued**

<http://www.socialstudiesforkids.com/articles/ushistory/wrightbrothers1.htm>

<http://www.nps.gov/wrbr/learn/historyculture/theroadtothefirstflight.htm>

<http://airandspace.si.edu/exhibitions/wright-brothers/online/who/1859/wilburOrville.cfm>

<http://www.flyingmachines.org/pend.html>

<http://durealeyes.com/helicopter.html>

<http://www.loc.gov/teachers/classroommaterials/primarysourcesets/flight/>

**HAND-LAUNCHED PROPELLER HELICOPTER***STUDENT /TEAM WORKSHEET**Name* \_\_\_\_\_**Design 1**

<b>Design 1</b>	<b>Trial 1</b>	<b>Trial 2</b>	<b>Trial 3</b>	<b>Average</b>
Estimated Height				

**How will you change the design to increase the height flown?****Design 2**

<b>Design 2</b>	<b>Trial 1</b>	<b>Trial 2</b>	<b>Trial 3</b>	<b>Average</b>
Estimated Height				

**Did the change improve the height flown? Yes or No****How will you change the design to increase the height flown?****Design 3**

<b>Design 3</b>	<b>Trial 1</b>	<b>Trial 2</b>	<b>Trial 3</b>	<b>Average</b>
Estimated Height				

**Did the change improve the height flown? Yes or No****How could you change the design to increase the height flown?****Which design flew the best?**